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ABSTRACT

In an effort to enlarge the debate on the use of worksheets within Scotland's schools, two teachers who use this approach extensively were invited to present their views, and other educators were invited to react to them. The first part of this report includes a discussion of teachers' views on learning, their perceptions on language development, their ideas for managing the learning environment, and their recommendations for managing the production, selection and use of worksheets. The second half of the report comprises appendices containing responses to the original viewpoints expressed and samples of additional types of worksheets. (MER)

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WORKSHEETS AND SCHOOL LEARNING

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by Roy Beavis & Colin Weatherley

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Figures 3b, 4a are reprinted from the Australian Science Education Programme "Heat and Temperature", ASEP Service booklet 152, State of Victoria, 1973.

Figure 5a is reprinted from the Scottish Integrated Science Teachers Guide, Dundee College of Education, published by Heinemann Educational Books, 1977.

Figures 9a, 9b, 9c, 10, 11, 12, 13, 14, 15 are taken from or incorporate elements from the New Science Worksheets published by Heinemann Educational Books, 1977.

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Foreword

The Scottish Council for Educational Technology, in its broad concern for all aspects of educational technology has an interest in the way in which worksheets are produced, used and evaluated as one amongst many strategies for learning. Any consideration of worksheets will readily reveal the wide range of quality and applications. It will also reveal a wide range of attitudes and responses from learners, teachers and theoreticians.

In an attempt to enlarge the debate on worksheets within schools SCET has chosen to publish the views of two school teachers who make extensive use of this approach to learning. Appended to these are reactions from others who have their own particular viewpoints. The views expressed are those of the authors and are not necessarily endorsed by SCET.

We are aware that there are many other views on the preparation and use of worksheets, indeed there may be readers who do not agree with the way they have been defined by the authors. This book is therefore presented as a *discussion document* and SCET would welcome your views and ideas for further development or publication in this field.

Richard N. Tucker
for SCET

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Worksheets and School Learning

INTRODUCTION

This is an essentially personal statement, related to our own commitment to certain educational concepts. For example, we believe that most learning is best accomplished in mixed-ability groups and we have a strong belief in the central and crucial role played by language in learning. Such beliefs are derived from a basic viewpoint outlined in the following section.

We must also stress that our own experiences have been mainly with science teaching in S1 and S2. Much of what we say will therefore be coloured by this limited experience. Nevertheless, we hope that there is enough of general validity to jusify the generalised title.

A VIEW OF LEARNING

Central to our approach to all educational experiences—in the context of which worksheet design and use must be seen—is our view of learning strategy. Learner/teacher relationships can be seen to exist on a continuum. At one end of this continuum is the essentially personal relationship established between a tutor or coach and his pupil. A good tutor begins with an analysis of his pupil's present position in relation to the knowledge, skills and attitudes which he wishes to develop. He then builds from this analysis in two main ways. Firstly, he responds to particular strengths and weaknesses of knowledge or skill by devising appropriate learning experiences. Secondly, he responds to his pupil's personality and hence to his attitudes by judging when to be demanding and when to praise.

At the other end of this continuum, by contrast, is the relationship between a lecturer and his audience. A lecturer cannot respond to individual characteristics in the learners. He supplies a set of experiences and the learners take what they can from these. What each individual takes from the experiences depends largely upon what he brings to them.

We believe that schools should aim to provide learning situations which lean more—though not exclusively—towards the "tutor" end of this continuum than towards the "lecturer" end. In short, we believe that the quality of teaching is greatly affected by the relationship between learner and teacher.

However, a close relationship between learner and teacher implies more than simply responding to the *learner's* attitudes. We must recognise that some of the *teacher's* attitudes will in turn affect the learner. Most teachers will surely agree that education is as much about the development of attitudes as of knowledge and skills. Perhaps the most important general attitude that we can help to develop is one of caring and we believe that this is more likely to develop in "tutor" situations, where it is easier to demonstrate that we ourselves care about the progress of each individual child.

The use of worksheets, then, should be seen within this context. *Like all good educational technology they should be designed and used to "personalise" learning by improving relationships between individuals.* This statement may seem like a discreet glimpse of the obvious but we have too often seen them used otherwise, to "depersonalise" learning. They should not simply be given to pupils to work through with the teacher adopting the role of supervisor, distant observer, or worst of all, examiner. Properly used, they can provide momentum to keep pupils working profitably and so free the teacher to circulate and respond to individual needs. We shall return to this them again (*see the section on Managing the Learning p. 12*).

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LANGUAGE DEVELOPMENT

Recent Schools Council publications (see Bibliography 1 and 2, page 29) have clearly indicated the various "audiences" for which a learner can write, and how his sense of audience can affect how he writes and consequently what he gains from a learning experience. This analysis has also shown that in schools we tend to ask pupils to write predominantly in a formal, "transactional" mode which is largely alien to younger secondary pupils, (see upper bracketed section in Fig. 4b, page 9. It has also shown that teachers tend to adopt the role of examiners, critically correcting each piece of writing. We believe that worksheets should encourage children to think, discuss, read and then write initially in their more natural, "expressive" mode (see Fig. 2(a), page 4) and that teachers can best help in this by adopting the role of "trusted partner" in the learning experiences. From such a start more formal, transactional writing can develop as appropriate (see Fig. 2(b)). Rather than trying to impose an alien mode of writing on children we should allow them to start with their natural expressive mode and encourage them to develop towards the transactional mode as they see the need to do so. *We should not treat knowledge as an absolute thing but rather as essentially personal to each learner.* The impact which new knowledge makes upon a learner's thinking depends very largely upon previous experiences. Therefore, as teachers we should try to provide situations which allow learners to rework new knowledge so that it fits into and where necessary alters their existing framework of ideas about the world. To do this we must allow them to "think aloud"; to talk about their experiences to fellow learners and to the teacher as a trusted partner, and if necessary to write in this thinking aloud, expressive mode until they have accommodated the new knowledge and clarified their ideas.

DEFINITIONS

While it may seem more logical to have started with definitions, we have delayed them until now because the foregoing discussion on language development has much relevance to this section.

There are many ways of defining and classifying worksheets. For the purposes of this discussion, however, we shall distinguish two kinds, commonly used in schools. The difference is in the ways that they are used and the consequences of their use, rather than in the parameters which should be used in their design. Although they are both commonly called worksheets we shall refer to them here, for convenience, as worksheets and workcards.

1. Worksheets

We define a worksheet as a consumable item, i.e. the learner is required to write on it. There is a particular danger with this type of sheet. If it is not carefully framed it can inhibit children's language development, and hence the effectiveness of their learning, by excessive use of closed questions and "fill-in-the-blanks" type exercises (Fig. 1).

Fig. 1 Excerpts from a first year secondary Geography worksheet.

The British Isles consists of _ _ _ _ countries. The largest and most important city on the map is _ _ _ _ _ _ _.

The United Kingdom is made up of the following countries:

E_ _ _ _ _ _ _, S_ _ _ _ _ _ _ _, W_ _ _ _ and N_ _ _ _ _ _ _ _ _ _ _ _ _ _ _.

It also includes the Isle of _ _ _ and the Channel Islands. It does not include the _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _. The most northerly country in the British Isles is _ _ _ _ _ _ _ _ _. Wales lies to the _ _ _ _ of England. The _ _ _ _ of _ _ _ _ _ lies mainly to the south of _ _ _ _ _ _ _ _. Between England and Ireland lies the _ _ _ _ of _ _ _ _. Across the sea to the south of England lies the country of _ _ _ _ _ _ _. The capital and largest city of the United Kingdom is _ _ _ _ _ _ _. London is the _ _ _ _ _ _ _ _.

Z

Some use of closed questioning is of course required at times, to lead pupils to certain conclusions. But overemphasis of this approach can prevent the kinds of language activities advocated in the previous section. This problem can be overcome by incorporating suggestions for extra language activities onto the sheets (see also Appendix). Perhaps the most valuable kind of such activity is the writing of a diary or letter of the lesson's events, imagining that it is to be read by a friend (Fig. 2). Such writing can become quite imaginative and may include full-blown stories and even poetry. While such activities may seem peripheral, we believe that they can motivate pupils and also help them to think round new concepts so that they can fit them into their existing framework of ideas.

Fig. 2. Two examples of extra language work from a first year science topic.

Dear David,

At science today we had an experiment today it was about energy it was very exciting. Our teacher is Mr Weatherley. The experiment was about custard powder and a candle. First you get a tin with a tight fitting lid, then a tube going into the side of the tin, you put some powder in. light the candle place the lid on tight, blow through the tube. Punch it right then Kapow! off shoots the lid followed by a 50cm's flame (~~flame~~) about (1½ foot)

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high. Then we wrote a quiz on the board. Then we got our books home about what I am writing now.

Sincerely yours
DAVID PAXTON

PS HOW are your experiments getting on.

(a) David's letter is a good example of "expressive" writing. He clearly believes that his own feelings, and incidental information such as the teacher's name, are as interesting to his reader as the details of the experiment itself.

Energy in Food

My teacher had on a desk a large tin with a tight lid and with a tube with a piece of rubber piping attached onto it. Inside the tin was a little pipe which my teacher filled with custard powder. The pipe was connected to the tube and plastic piping. Also on the tin was a small candle. My teacher lit it and put the lid on tight. Then through the piping he blew and the custard powder went over the candle and made a bang and went on fire. For you see then custard powder had chemical energy in it and when the powder touched the flame it exploded then set the dead bit of powder on fire.

So chemical energy was changed to sound energy and light energy and heat energy. For when the fire was out the tin was hot. So it was chemical energy → sound, light, heat movement. For the chemical energy made light, sound and heat energy.

(b) This piece is very close to pure "transactional" writing. The pupil has a mature command of language and has used this to produce a formal, "public statement" rather than a personalized account.

2. Workcards

While many workcards are superficially similar to worksheets the crucial difference is that they are re-usable because pupils do the associated written work in a separate jotter or diary. The main advantage of this method—apart from a possible saving in cost—is that it frees the learner from the restrictions on writing space involved with worksheets. Hence, it is probably easier to encourage a more consistent approach to expressive language use with workcards than with worksheets. Unfortunately, such opportunities are not always taken, particularly when workcards are used to direct pupils to find and copy out passages from text books in answer to closed questions.

READINESS TO LEARN

In his recent book "Human Characteristics and School Learning" (3) Benjamin Bloom presents a powerful model of learning. He suggests that each learning task has inputs and outputs which he characteristically terms "Cognitive Entry Behaviours", "Affective Entry Characteristics" and Cognitive and Affective "Outcomes". According to his model the successful completion of a learning task requires that a learner should have the appropriate entry behaviours and characteristics—that is, he should possess the necessary *knowledge and skills* to master the task and should also be adequately *motivated.* We believe that it is helpful to consider the design and use of worksheets in relation to this model. We shall therefore consider in turn, "*language skills*", "*subject-based knowledge and skills*", and "*motivation*".

1. Language Skills

Whilst each learning task involves a number of subject-based concepts and skills, language skills are of fundamental importance to *all* learning. It is therefore particularly important to write worksheets in language suitable to the learner's stage of language development. He has little chance of mastering new concepts, for example, if he cannot understand the language in which they are presented.

We have encountered the view that the use of simple language on worksheets inhibits pupils' language development. However, we believe that this is wrong for two reasons. Firstly, worksheets can best help language development by encouraging pupils to talk and write from their existing stage of development towards more formal and hence more generally useful modes, as already discussed. Secondly, worksheets should not be used in isolation, to create an "impoverished learning environment". Rather, they should be used together with other resources such as reference books and audio-visual material. If such an approach is adopted it is possible to cater for a full range of ability by producing worksheets at a simple reading level, and yet still encourage those of high language ability to develop their skills further, thereby deepening their understanding of the topic under study, through the use of these additional materials (see Fig. 5, pp. 10, 11, 12).

2. Subject-Based Knowledge and Skills

The teaching of a new learning task will obviously be more effective if the teacher has a clear idea of the extent to which each learner has mastered the pre-requisite knowledge and skills for the task. The first step in such assessment is to outline the main learning objectives of the topic. This then enables us to decide on the pre-requisite knowledge and skills required to achieve these objectives. The next step is to devise a series of questions to test each pupil's mastery of such knowledge and skills, i.e., his "readiness to learn" the new topic (see Fig. 3). The teacher can remedy any deficiencies here by discussion with individuals or groups, or by providing suitable preliminary worksheets such as the "Heat and Temperature" sheet shown in Fig. 4a (p. 8).

Fig. 3(a)

READINESS TEST

Before you begin the next section (Skin Helps Regulate the Temperature of the Body), you need to know how heat can be transferred. If you do not know, you will not be able to understand this section fully.

To check just how much you know, you will need to do the Readiness Test in ASEP's *Heat and Temperature.* Record your answers on page 7 of your record book.

This is not a test for marks. You will be checking your own answers. If your answers show you do not know enough about heat transfer, you should work through *Heat and Temperature* before going on with *Skin and Clothes.*

Fig. 3(b)

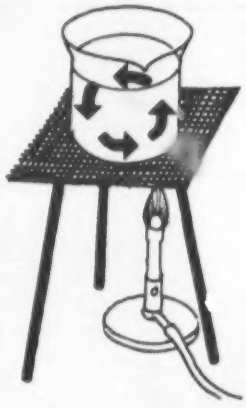
Readiness Test

This book is designed to enable you to learn certain things about heat. In order to help you find out if you need to work through this book, you should first answer the following questions.

For most questions you have to choose the best answer from the several answers suggested. In each of these cases, write only the letter of the answer which you choose. There are other questions in which you are required to write one or more words to complete a sentence. Write your answers in your notebook.

It is important that all your answers are your own work.

1 The diagram at right shows a beaker of water being heated. The arrows show the movement of heated particles.



Heat is being mainly transferred through the water by

A convection.
B conduction.
C radiation.
D reflection.

2 If one end of a copper rod is held in a gas flame, heat travels quickly along the bar to the other end. Substances like copper which behave in this way are called fast

A reflectors.
B insulators.
C radiators.
D conductors.

Fig. 3. Readiness Test from the Australian Science Education Project (ASEP) Unit: "Skin and Clothes" (1974). The test is divided into two parts, related to the two sections of the topic "Heat and Temperature". A sample worksheet from this latter topic is shown in Fig. 4.

The main topic worksheets should each be related to a selection of the learning objectives which thus have two uses. Firstly, they provide a framework around which each worksheet can be constructed—or from which a suitable selection of published materials can be made. Secondly, they provide a valuable guide for the construction of questions to assess mastery of the knowledge and skills conveyed in the topic. Of course, worksheets themselves may form part of such assessment. In the Wester Hailes material shown in the Appendix, for example, every worksheet has an assessment as well as teaching function.

3. Motivation

We may state Bloom's "Affective Entry Characteristics" alternatively as "motivation to learn". Such motivation can in turn be seen to have external and internal components.

(*a*) *External motivation* can in part be provided by the "audience" for which a learner writes; in many cases this can be quite a critical factor. Most of us will have encountered pupils who need to be highly motivated by encouragement before they will start a learning task. One of us at present teaches a class of remedial pupils, one of whom would scarcely put pen to paper, presumably because of previous discouraging experiences. Here the value of providing an alternative audience became apparent. Several of the class were encouraged to form a Science Club (as much a social as a working environment) and to carry out work to display to their parents. This particular pupil soon became enthusiastic about the idea and began to write up the work on large sheets of display card. This external motivation then carried over to the more formal laboratory learning and beyond for within a short time it became clear that his writing skills were improving in a number of other subjects. Moreover, as a result of his growing mastery of writing skills he began to gain *internal motivation* to improve his reading skills as explained in part (b).

The other major means of providing external motivation is of course through attractively presented learning materials designed to arouse curiosity and interest. Such materials can obviously include standard "information-and-instruction" worksheets (see Fig. 4(a)) but in addition materials such as "quick quizzes" (i.e. tests for mastery), crosswords, educational games, cutting and pasting and colouring exercises can all be used to heighten interest and hence motivation. Examples of these latter types of materials are shown in the Appendix A (see page 25 for example).

Figure 4 shows two contrasting examples of worksheets. Example (a) has many features designed to increase motivation to learn, viz:

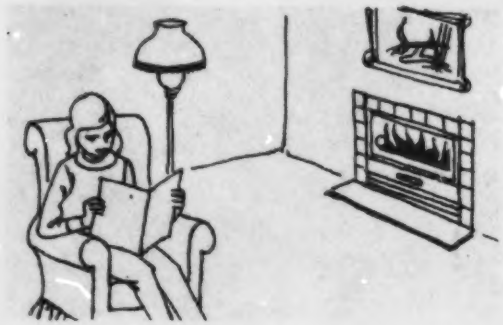
(i) the information is presented in simple language, well spaced out;
(ii) possibly unfamiliar words such as "transferred" are explained in simple language;
(iii) practical instructions are clearly marked out from other information;
(iv) questions are denoted by a clear symbol;
(v) important new words (e.g. convection) are picked out in bold type;
(vi) lower case printing is used predominantly. (There is, incidentally, substantial evidence that lower case print is easier to read than capitals.)

By contrast, example (b) has a number of features likely to minimise motivation, viz:

(i) the printing is in capitals throughout, making it more difficult to read;
(ii) there is minimal visual distinction between questions, theory information and practical instructions;
(iii) the major part of the sheet consists of a relatively monotonous sequence of words. The result *looks* forbidding, whether or not the language itself is difficult to follow;
(iv) the only illustration does not make the sheet more visually attractive or easier to follow. Illustrations like that of the beaker, tripod and burner in example (a) could have been used to good effect in the middle, instruction section of this sheet.

Heat Transfer

When you sit in a room warmed by a space heater . . .



or you hold a hot water bottle . . .

or you sit in front of a fire . . .

heat is **transferred** to you.

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In each case, heat is transferred (moved) from something warmer to something colder.

You can find out more about heat transfer on the following pages.

Convection

Fig. 4(a)

ACTIVITY 1:
CONVECTION IN WATER

You will need:

- 1 glass beaker, 250 ml
- 1 burner
- 1 tripod
- 1 mat
- 1 crystal of potassium permanganate
- 1 small spoon (or spatula)
- matches.

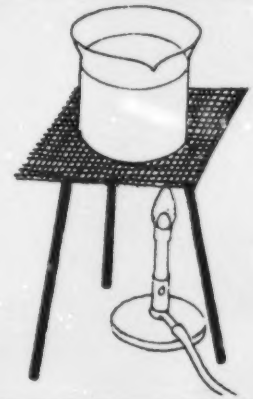
Add water to the beaker until it is almost full.

Set up the beaker, tripod and mat as shown.

Wait for the water to become still—this will take at least one minute.

Using the spoon, drop the crystal of potassium permanganate into the water as close as possible to the side of the beaker.

Now light the burner and place it directly under the crystal.



Whenever you see this hand symbol you will need to write something in your notebook.

1 What happens to the purple dye from the crystal? (Answers to numbered questions throughout this book are given a page or two after the questions. For example, you can check your answer to this question on the next page.)

The way the dye moves shows how the water moves. The warm water above the heater rises, and the cooler water moves downward to replace it. Liquids move this way when heated.

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This type of heat transfer is called **convection**.

Fig. 4(b)

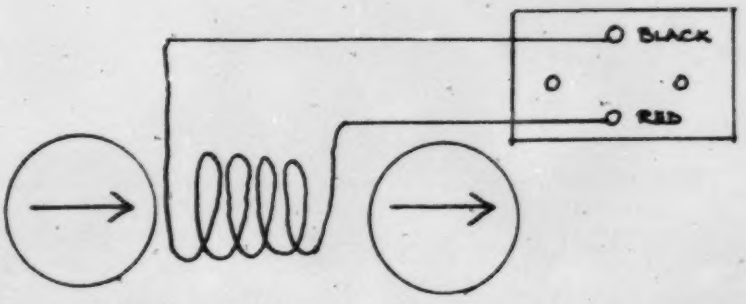
QUESTIONS CONTINUED

4. WHAT HAPPENS TO THE DIRECTION IN WHICH THE COMPASS NEEDLE POINTS WHEN THE DIRECTION OF THE CURRENT IS REVERSED?

READ AND COPY THIS:

WHEN THERE IS AN ELECTRIC CURRENT IN A WIRE A MAGNETIC FIELD IS PRODUCED AROUND THE WIRE, THE DIRECTION OF THE MAGNETIC FIELD DEPENDS ON THE DIRECTION OF THE CURRENT IN THE WIRE. IF THE DIRECTION OF THE CURRENT IS REVERSED THEN THE DIRECTION OF THE MAGNETIC FIELD CHANGES.

FROM ABOUT ONE THIRD OF THE WAY ALONG THE WIRE WIND FIFTEEN TURNS OF WIRE AROUND YOUR PEN OR PENCIL. CONNECT THE ENDS TO THE RED AND BLACK TERMINALS OF THE POWER SUPPLY. AFTER SLIDING THE COIL OFF THE PEN OR PENCIL. LAY THE COIL FLAT ON THE BENCH AND PLACE THE TWO PLOTTING COMPASSES AT EITHER END OF THE COIL. SWITCH ON THE POWER SUPPLY AND NOTE THE DIRECTION THAT THE TWO COMPASSES POINT IN. SWITCH OFF, REVERSE THE CONNECTIONS AND SWITCH ON AGAIN, NOTE THE DIRECTION IN WHICH THE COMPASS NEEDLES NOW POINT.



ANSWER THE FOLLOWING QUESTIONS AND DRAW THE SKETCH ABOVE.

1. WHAT HAPPENS WHEN YOU SWITCH ON?
2. WHAT HAPPENS TO THE DIRECTION OF THE MAGNETIC FIELD WHEN THE DIRECTION OF CURRENT IN THE COIL IS REVERSED?

(*b*) *Internal motivation* comes from within the learner as a response to successful learning experiences. "Nothing succeeds like success". This implies again that we should relate both language *and content* to the present state of the learner's development—erring where necessary towards the easy rather than the difficult side. There is not space in an article of this length to discuss in detail the relationship between worksheet content and the age of the learner. However, it would be inappropriate to pass over the matter without mentioning the work of Jean Piaget and the insight which this has given us into the development of children's abilities to grasp concepts (see references 4, 5 and 6). Certainly all teachers are aware that children's abilities to grasp new ideas and master new skills do vary widely. While such variation can no doubt be minimised by suitable educational experiences, including remedial help, it will never disappear and we therefore need to take account of this in designing or selecting our worksheets. The "basic" sheets should then be at the simplest appropriate level of language and content to cater for all the learners, and the full range of ability *and interest* be provided for by a suitable range of learning *materials* (not just worksheets).

The New Scottish Integrated Science Scheme illustrates one attempt to provide learning materials at suitable levels for all learners (Fig. 5(a)). This scheme was produced as a result of problems with the original scheme which had been primarily, if not consciously, aimed at pupils in the middle of the ability range. Consequently the original worksheets presented problems for pupils at the extremes of the range. The writers of the new scheme therefore devised "core sheets" aimed at all pupils, with reinforcement material for pupils with learning difficulties and extension materials for the above average and most able. This is a valuable approach which provides a useful model for other subjects—though it can also be modified in various ways. For example, the Wester Hailes material (Appendix) is based on this approach but with several modifications.

A second approach is to provide core sheets with a simple level of language and content, and a range of options, varying in content and language difficulty, at the end of the core (Fig. 5(b)). A third method (Fig. 5(c)) consists of a choice of worksheets and allied materials from the start of a topic, each pupil's route depending upon a pre-test and subsequent diagnostic tests.

Fig. 5(a).

The basic model (suitable for mixed ability classes)

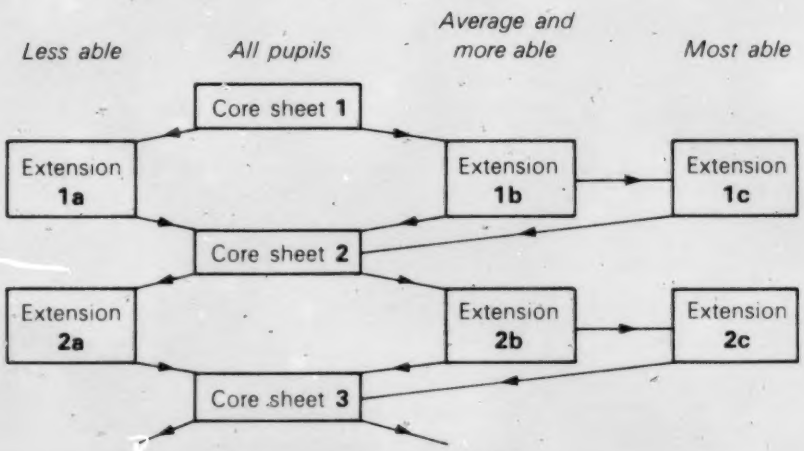


Fig. 5(b)

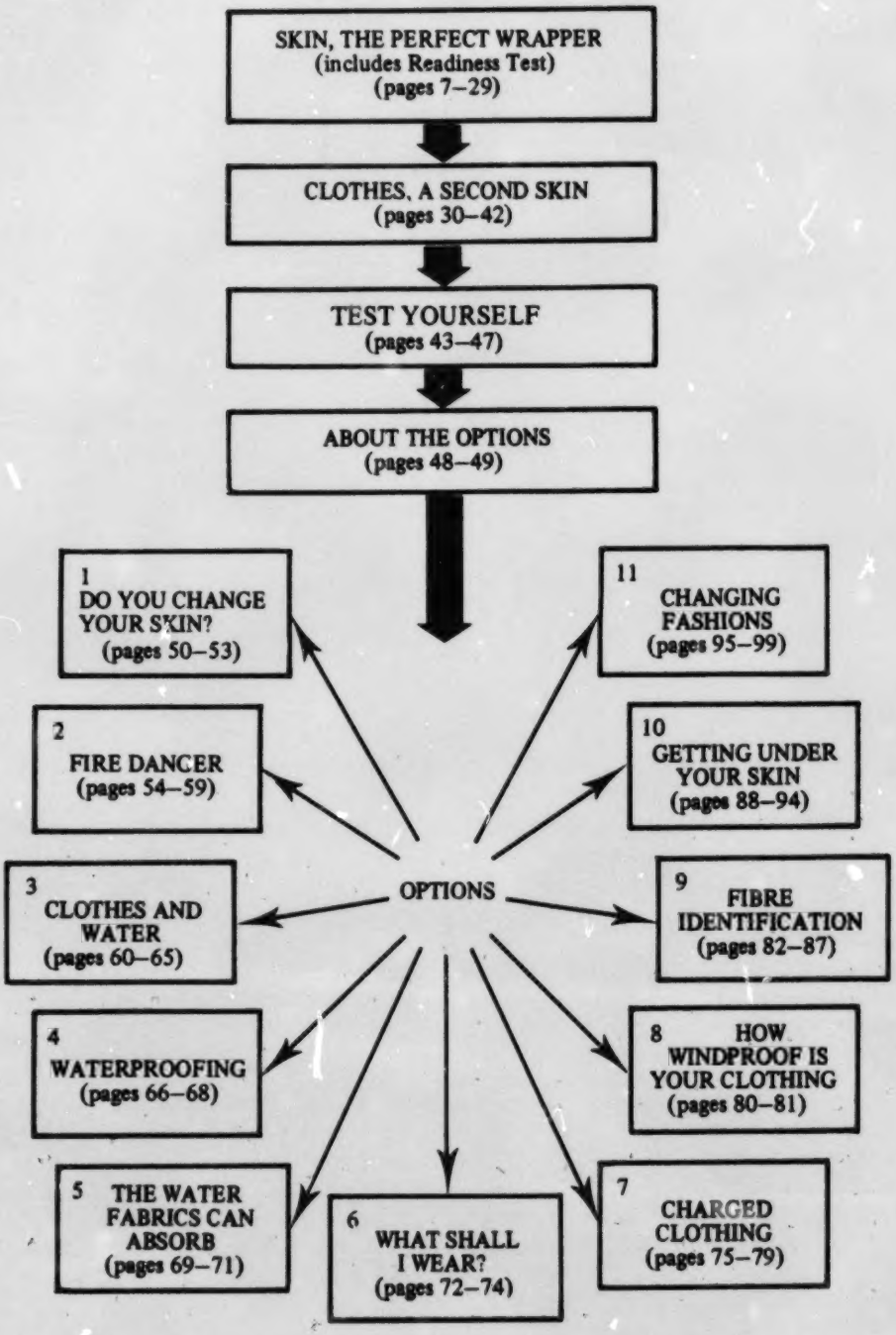

SKIN, THE PERFECT WRAPPER
(includes Readiness Test)
(pages 7–29)
CLOTHES, A SECOND SKIN
(pages 30–42)
TEST YOURSELF
(pages 43–47)
ABOUT THE OPTIONS
(pages 48–49)
OPTIONS
1
DO YOU CHANGE YOUR SKIN?
(pages 50–53)
2
FIRE DANCER
(pages 54–59)
3
CLOTHES AND WATER
(pages 60–65)
4
WATERPROOFING
(pages 66–68)
5
THE WATER FABRICS CAN ABSORB
(pages 69–71)
6
WHAT SHALL I WEAR?
(pages 72–74)
7
CHARGED CLOTHING
(pages 75–79)
8
HOW WINDPROOF IS YOUR CLOTHING
(pages 80–81)
9
FIBRE IDENTIFICATION
(pages 82–87)
10
GETTING UNDER YOUR SKIN
(pages 88–94)
11
CHANGING FASHIONS
(pages 95–99)

Fig. 5(c)

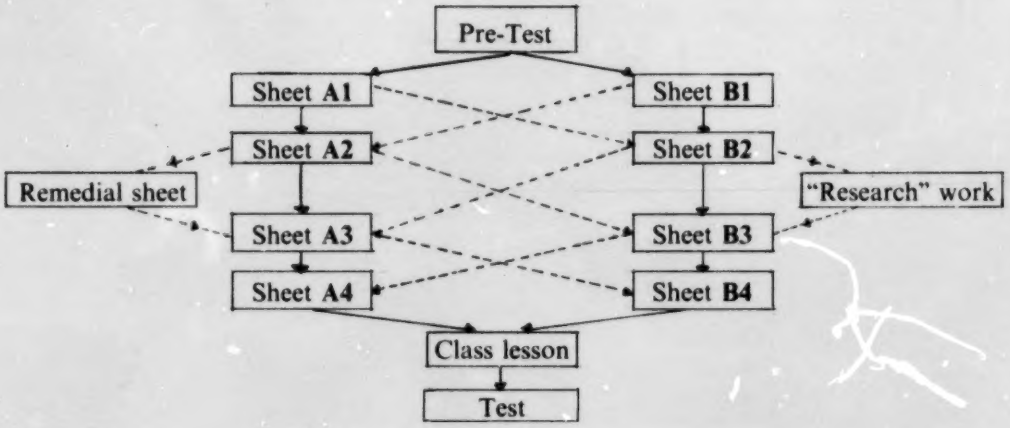


Fig. 5. Three different ways of organising worksheets and other resources to cater for a wide range of learning rates and abilities. (a) is from the New Scottish Integrated Science Scheme (10) and (b) from the Australian Science Education Project (6, 7). Example (c) indicates another possible arrangement. The solid arrows show alternative routes taken by most children, based on the pre-test. However, they are not prescribed and the dotted arrows indicate that individuals may in fact change route, depending upon their performance in subsequent activities.

There are of course further variations on these patterns. The decision as to which to adopt will depend upon subject demands and staff inclinations, and may also vary throughout a particular course.

If successful learning experiences can provide motivation to learn further, *recognition* of such success must reinforce this motivation. The primary school "star" system may have its critics but there is no doubt that it provides strong motivation. One of us has adapted this idea to secondary science, calling it a "credit" system (see Appendix p. 20). This is allied to self-assessment, where the pupils take 'quick quizzes" (diagnostic tests) at regular points and check their own answers before moving on or referring to the teacher. This combination of self-assessment with credits seems to provide particularly strong motivation.

MANAGING THE LEARNING

Our central argument is that learning occurs best when there is time for pupils and teachers to think, discuss, argue and write as individuals and small groups. If we are to encourage this development of tutor/learner relationships however, we must allow more time for teacher and learner to talk together. This is difficult to achieve in the standard single or even double period since there is rarely time for a teacher to participate in these activities with all pupils. Therefore we recommend that all schools should consider timetabling larger blocks of teaching time to most subjects. Clearly, too, class sizes should be reduced as far as possible though unfortunately this solution lies largely outwith the control of individual schools.

Whatever the size of learning group or the length of teaching period, we should try to devise methods which allow us to keep an oversight of the progress of each individual with relative ease. Here there is an allied problem; if the teacher is not continually aware of each pupil's progress—or lack of it!—there is a danger that he may spend an inordinate amount of time with particularly demanding pupils, while some quieter member of the class ploughs relentlessly on despite having failed to grasp an important concept. This is not only wasteful of learning and teaching time; it can also very effectively de-motivate just the kind of pupil who needs most to be motivated.

There are various ways of tackling this problem. One is to use a wall chart (Fig. 6) which can even be prepared by one of the class, and which the pupils themselves fill in to indicate when they have covered a particular piece of work and had it checked.

CLASS: 2D	*SECTION 9*									*MAY 1979*				
Name	Main Activities									Extras				
	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	1	2	3	4	5
Gillian Barrett	√√	√√	√√	√√	√	√				√√	√√			
Gillian Clark	√√	√√	√√	√						√√				
Julie Harris	√√	√√	√√											
Kathleen Millar	√√	√√	√√	√√	√√	√√	√			√√	√√	√		

Fig. 6. Wall chart used to show the progress of each member of a class through a topic of work. Each pupil charts his or her own progress as they complete each new piece of work and collect a ticket (see text). One tick indicates that the work has been completed; two ticks, that it has been checked by the teacher. Alternatively, *if the whole class agrees*, the actual marks gained for each piece of work can be entered.

One of us uses this method in conjunction with a ticket system. Whenever a pupil finishes a worksheet he collects a numbered ticket before going on to the next piece of work. After checking and discussing the work of an individual or group the teacher calls out the next number in the sequence. This gives a fair distribution of attention to all pupils, though inevitably the sequence has to be broken from time to time to deal with emergencies and serious learning problems.

Another ploy, used to good effect in the New Scottish Integrated Science Scheme, is to have a "Checkpoint". Pupils must then refer to the teacher before proceeding past such a point. The Wester Hailes course uses this approach but with additional materials as described fully in the Appendix.

There are of course other equally effective ways of managing the learning. Whichever method is adopted, however, should allow the teacher to keep a clear oversight of the progress of all pupils with the minimum expenditure of time and effort, so that he is able to devote maximum time and effort towards helping each individual pupil progress with his work.

MANAGING THE PRODUCTION, SELECTION AND USE OF WORKSHEETS

Worksheets are used as the basic learning resource in an increasing number of school courses, particularly in S1 and S2. Economic pressures are such that worksheet based learning has become an expedient alternative to a more varied but costly learning diet. Consequently there is a danger of schools unwittingly creating an impoverished learning environment by submitting pupils to the inappropriate use of worksheets across the curriculum. Therefore we would urge all schools to develop ways of monitoring and controlling the use of worksheets across the curriculum and of disseminating general philosophy and ideas on worksheet use such as those expressed in this article.

Worksheet management and production cannot and should not be considered in isolation from other resources. Indeed, in schools which have developed resource-based learning, worksheet design and production is often the main concern. An important part of resource management strategy is to support the subject departments in course planning and production with expertise, information and advice. This involves maintaining up-to-date resource information by developing two-way links with local and national resource centres, and providing lists and samples of commercially available worksheets. Indeed, this latter task may well be the single most important function of a resource centre since a great deal of time and energy can be saved, and the quality of the final products improved, by the judicious use of commercial materials. Schemes such as A.S.E.P. and the New Scottish Integrated Science course, for example, have been produced after years of work by hand-picked teachers followed by trials and re-writing where necessary. It would clearly be foolish to pass over such materials, through ignorance or cussedness, if they fit into our overall course structure. Not that we are advocating the exclusive use of such external materials; it is rather a matter of balance. The ideal arrangement, we believe, is for the school department firstly to decide on its course objectives and content, then to research the market with the aid of school, local and national resource centres; to select materials which will suit, and finally to add to, amend or use them as models for internally produced sheets.

Within subject departments, in planning and producing courses teachers have to be aware of the possibilities and limitations of worksheets in relation to their course objectives. Worksheets ought to be used as part of a strategy to achieve the overall aims of a course and their construction should therefore be shaped by particular objectives. Ideally, the main function of the sheets will be to introduce pupils to a variety of learning activities. The casual use of worksheets, produced by individual teachers as "fillers" to be used as a substitute for more demanding learning activities, must be avoided. Effective courses making appropriate use of all resources are more likely to be produced through team writing, which harnesses and applies the collective wisdom and expertise of staff from within and outwith a department—including resource experts and remedial specialists.

SUMMARY OF THE MAJOR PARAMETERS OF WORKSHEET SYSTEMS

1. Worksheet systems should be designed to:

(i) encourage "personalised learning" by generating pupil/pupil and pupil/teacher interaction;
(ii) improve motivation of all pupils by
- arousing curiosity and interest
- providing opportunities for success and a means for "public recognition" of this success
- permitting a measure of pupil choice and control over their learning;

(iii) achieve the course objectives specified for all the pupils;
(iv) promote language development for all pupils by encouraging reading, writing, talking and listening.

2. Worksheet systems should include these characteristics:

(i) the content and style must be related to the course objectives;
the language must be at an appropriate level for the learners;
(iii) the content must be at an appropriate level for the learners—particularly at starting points;
(iv) techniques must be incorporated to promote pupil/pupil and pupil/teacher interaction (e.g. checkpoints or tickets);
(v) a simple system for recording and assessing progress which involves the pupil and so promotes motivation;
(vi) the structure should give pupils a measure of control over their learning by allowing them to organise their learning activities and choose from options.

3. Worksheet systems may include sheets designed to:

(i) provide both background and "after-the-event" information;
(ii) instruct "what-to-do" and "what-to-write";
(iii) ask questions which encourage the formulation of conclusions (closed questions in a logical sequence) or encourage speculation (open-ended);
(iv) encourage a variety of group and individual activities—thinking, talking, reading, writing, drawing, doing things such as making, observing, experimenting;
(v) act as reference material when completed;
(vi) act as and incorporate assessment material.

Appendix A

THE WESTER HAILES EDUCATION CENTRE (W.H.E.C.)—SCIENCE S1 and S2 MATERIALS

W.H.E.C. Science S1 and S2 is based on the New Scottish Integrated Science course—a worksheet-based course designed for the entire ability spectrum (see Fig. 5(a) p. 10). The Science staff have adapted the course materials for use with mixed-ability groups of 60 students taught by a team of 4 teachers in purpose built open-plan accommodation. As with the national course, the worksheets are structured in terms of language and content so that all students can work purposefully and successfully at a realistic level. This sample of the materials illustrates some of the innovations introduced into the system and some of the types of sheets which have been added to increase the range of the learning activities.

Additional extension material has been added to provide a greater variety of learning activities for all students so that those at the extremes of the ability spectrum can work more or less in phase at the appropriate level. Interaction between students working on the same topic is encouraged. (Highly structured worksheet systems which encourage individualised learning can often deny this form of enrichment, so important in developing social skills such as co-operation and communication). The additional material includes quizzes (p. 20), information sheets (pp. 23 and 24) and language activity sheets such as word searches and crosswords (pp. 27 and 28).

Assessment of student performance does not depend solely on unit tests—all the worksheets function as assessment material. Individual progress is recorded on a unit guide sheet (p. 17). At checkpoints (at the bottom of p. 19) the student is committed to discuss with the teacher the responses on the worksheet as well as practical and other problems which may have arisen in the course of the work. The teacher assesses student performance and allocates further work accordingly. Credits are awarded for achieving the specific learning objectives and these are recorded against the particular activity on the guide sheet. The student then makes his own highly visual presentation of his credit score in the thermometer-type scale on the Unit cover sheet (p. 16). *Each learning activity has the same credit rating* so that the system does not discriminate against the least-able students. This simple version of the "star" system has considerably improved the motivation of less-able students.

In addition, students participate directly in assessment by operating self-tests—the "quick quizzes" (p. 20)—which assess comprehension of the core activities. When the teacher is unavailable at the core checkpoint students can proceed to the quizsheet without consulting the teacher. Core sheets and quick quizzes are designed so that most students will complete them successfully. Students who experience difficulty must consult the teacher before proceeding to extension activities. Through operating the self-tests and the credit system the students come to perceive assessment as an essential and enjoyable aid to learning.

Page 16: Front Cover
Page 17: Master Guide
Page 18: Core Sheet
Page 19: Core Sheet
Page 20: Quick Quiz
Page 21: Extension Sheet
Page 22: Extension Sheet
Page 23: Information Sheet
Page 24: Information Sheet
Page 25: Activity Sheet
Page 26: Language Activity Sheet
Page 27: Language Activity Sheet
Page 28: Language Activity Sheet

Fig. 7

Name :

Class :

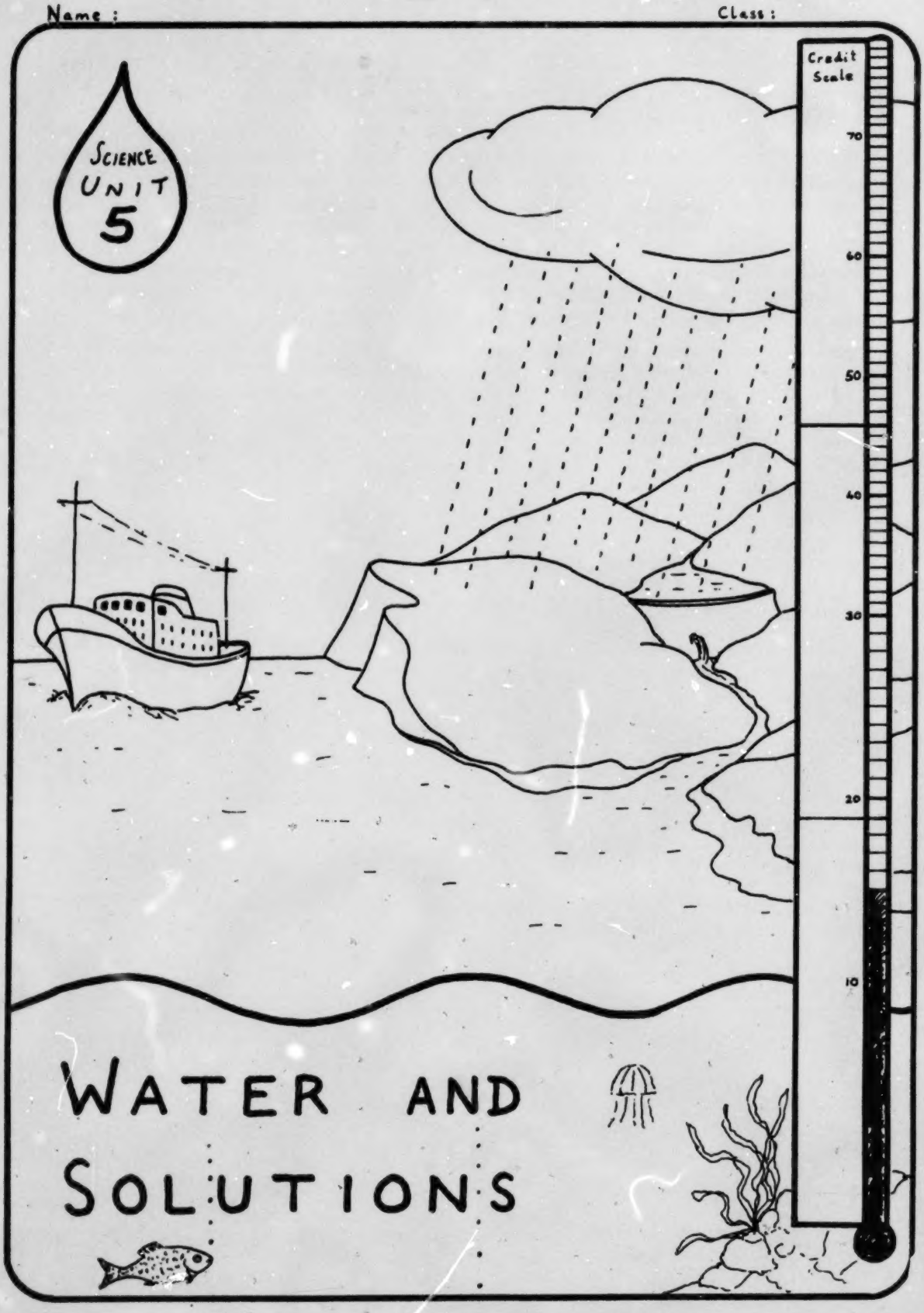


Fig. 8

Name: Class:

UNIT 5 WATER AND SOLUTIONS Guide Sheet

TOPICS		CORE ACTIVITIES	credits	EXTENSION ACTIVITIES	credits
5.1 Changes of State	a	Melting Ice	2	(e) Melting Points	2
	b	Boiling Water	2	(A) Water Molecules	2
	c	Changing State	2	(g) Colour Front Cover	
	d	Quick Quiz Score =	1		
5.2 The Water Cycle	a	Water Cycle Diagram	2	(e) Salting Ice	1
	b	Making Clouds		(f) Boiling Salt Water	
	c	Water Cycle Questions	1	(g) Made of Water	
	d	Quick Quiz Score =			
5.3 Evaporation	a	Timing Evaporation		(A) Energy and Evaporation	
	b	Drying Out		(e) Water Crossword	
	c	Quick Quiz Score =			
5.4 Dissolving	a	Soluble and Insoluble		(e) Particle Picture	
	b	How Soluble		(f) Solution Word Search	
	c	Speeding Up Dissolving			
	d	Quick Quiz Score =			
5.5 Colloids	a	Comparing Mixtures		(e) Testing Other Liquids	
	b	Colloid Notes			
	c	Examining Tea			
	d	Quick Quiz Score =			
5.6 Emulsions	a	Oil and Water		(e) Colloid Display	
	b	Emulsion Notes		(A) Colloid Types	
	c	Salad Cream			
	d	Quick Quiz Score =			
5.7 Growing Crystals	a	Watching Crystals Grow		(e) Examining Other Crystals	
	b	Crystal Display		(f) Crystal Ball Maze	
	c	Crystal Shapes			
	d	Quick Quiz Score =			
5.8 Solvents	a	Different Solvents		(e) Solvents for Permanganate	
	b	Removing Nail Varnish		(f) Solvents for Iodine	
	c	Dry Cleaning		(g) Anagrams	
	d	Quick Quiz Score =			
5.9 Cleaning Water	a	Filtering Water		(f) Evaporating Tap Water	
	b	Evaporating Filtered Water			
	c	Distilling Water			
	d	Evaporating Distilled Water			
	e	Quick Quiz Score =			
5.10 Our Water Supply	a	How We Get Our Water		(e) Water Pollution	
	b	Model Filter Bed		(A) How Much Rain	
	c	Using Water		(g) The Sewage Works	
	d	Quick Quiz Score =			

		credits
5.11	REVISION	
5.12	Practical Test Score =	
5.13	UNIT TEST	

OPTIONS

5.14 Chromatography	(a) Separating Dyes		5.16 Floating & Sinking	(A) Floating in Water	
	(b) Separating Biro Ink			(b) Weights in Water	
	(c) Testing Felt Pens				
5.15 Water Pressure	(a) Water Levels		5.17 Water Life	(a) Large Pond Creatures	
	(b) Water Fountain			(b) Small Pond Animals	
	(c) Water Syphon			(c) Pond Plants	
	(A) Water Depth			(d) Desert Survival	

23

22

Fig. 9(a)

Nathalie Tarretta

Changes of State

5.1 **a–c**

a Melting ice

Hold the thermometer in the melting ice.

The temperature of the melting ice is 0 °C.

2

This is called the **melting point of ice**
This is the same as the **freezing point of water**

b Boiling water

Find the temperature of the water.
Write it in the box marked °

Light the bunsen burner and start the clock.

Every 2 minutes take the temperature of the water and write it in the table.

Time in minutes	start	2	4	6	8	10	12				
Temperature	20°	50°	85°	99°	100°	100°					

How hot does the water get ? _____ °C.

2

This is called the **boiling point of water**

Boiling point of water is 100 °C.

Freezing point of water is 0 °C.

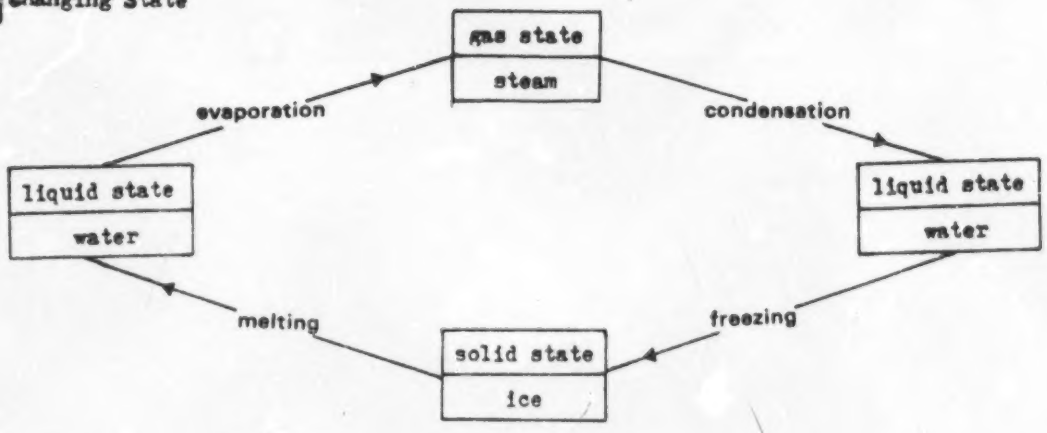
Melting point of ice is 0 °C.

Put away the equipment you used before going on to the back of this sheet.

24

Fig. 9(b)

Changing State



Put the correct word for the change of state under each picture.

hair dries

Evaporation

puddles dry up

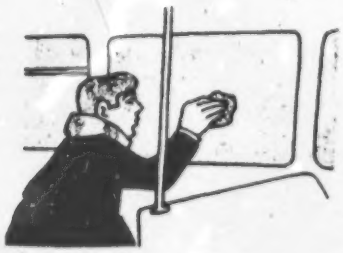
evaporation

icicles form on trees

freezing

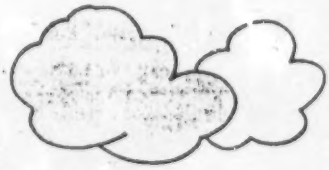
iceberg gets smaller

melting



bus windows mist up in winter

condensation



clouds form in cold air

condensation

2

Give two everyday examples of water changing state.

Snow disappears melting

Freezer Freezing.

Checkpoint RGP

25

Fig. 9(c)

QUICK QUIZ 5.1d

Without looking at your sheets try answering these questions.
Mark your answer choices on a small answer grid.

1. What is the melting point of pure ice?

A	-5°C	B	0°C	C	10°C	D	100°C

2. At what temperature does pure water boil?

A	0°C	B	10°C	C	80°C	D	100°C

3. For water 100°C is
   A the melting point
   B the freezing point
   C the boiling point
   D the evaporation point.

● Choose the correct change from this list

for: 4. melting
5. boiling
6. freezing
7. condensation
8. evaporation

A liquid changes to gas
B liquid changes to solid
C solid changes to liquid
D gas changes to liquid

● Choose the correct word from this list

for the changes of state of water

in the two pictures shown:

A melting
B evaporating
C condensing
D freezing

9.

hair dries

10.

bus windows mist up in winter

Mark your own answer grid using a check card.

Return this card and the small check card.

Fig. 10

Melting

5.1 (e)

1 **Place the three test-tubes in the water bath and heat gently.**

Do all the solids melt?

Which melts first? .....

Which melts last? .....

Do all these solids melt at the same temperature?

Explain why ice melts in your hand but wax does not. ... .

.....

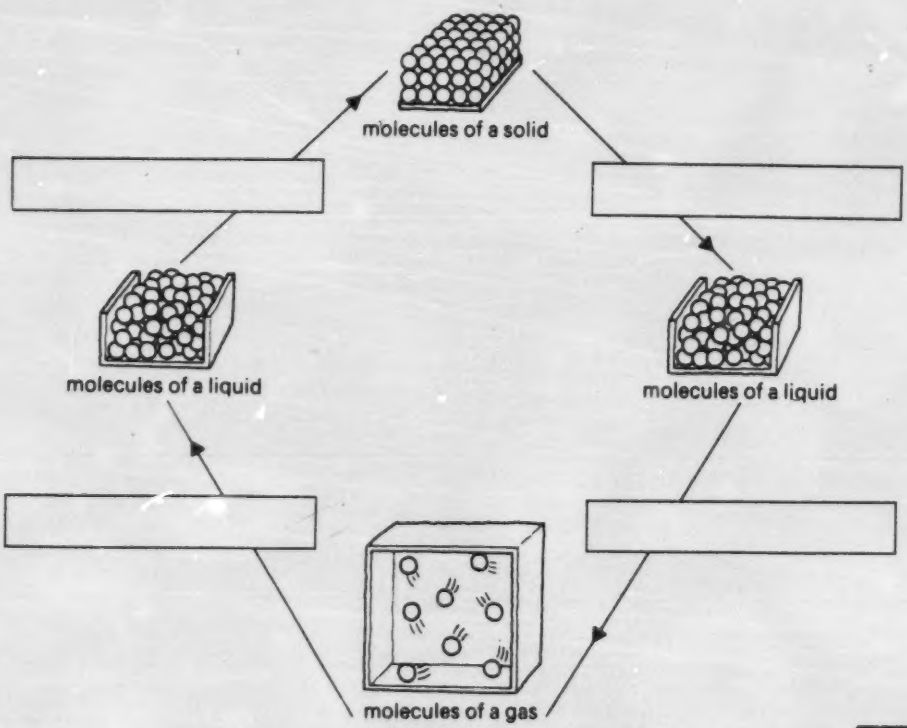
.....

Do not wash out the test-tubes. Put them back in the correct racks.

---

2 Put the correct word from the list in each box.

melting, freezing, evaporation, condensation



Checkpoint

Fig. 11

Water molecules

5.1 f

1 Using the model, label this diagram to show which part stands for oxygen and which for hydrogen.

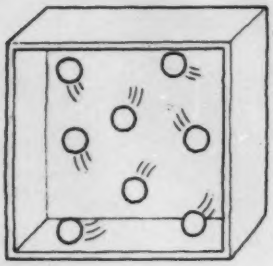
Why does H_2O stand for water? .....

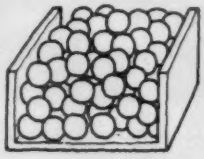
.....

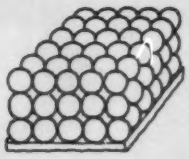
---

2 Put the correct word under each diagram:

water, ice, steam







....

The molecules are furthest apart in .....

The molecules are moving fastest in .....

---

3 When you heat water does it become hotter? .....

When you heat **boiling** water does it become hotter? .....

If you continue to heat boiling water what happens? .....

.....

---

4 Complete these sentences.

As a liquid changes into a gas its molecules are moving ..... and are further

.....

Moving the molecules further apart suddenly takes a lot of .....

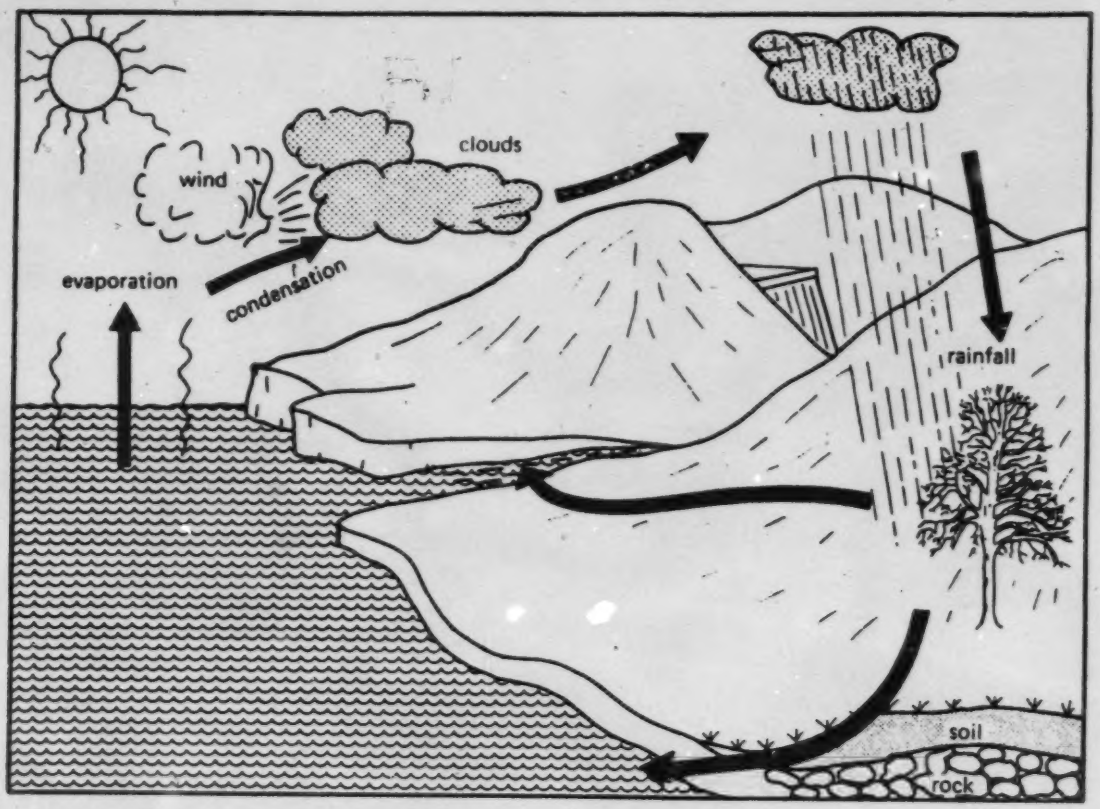
As the heat energy is used to push the molecules further apart neither the boiling water nor the steam become any .....

Checkpoint

Fig. 12

5.2 (1)

The Water Cycle



The picture shows how water goes round and round in what is called *the water cycle*.

This is how the water cycle works.

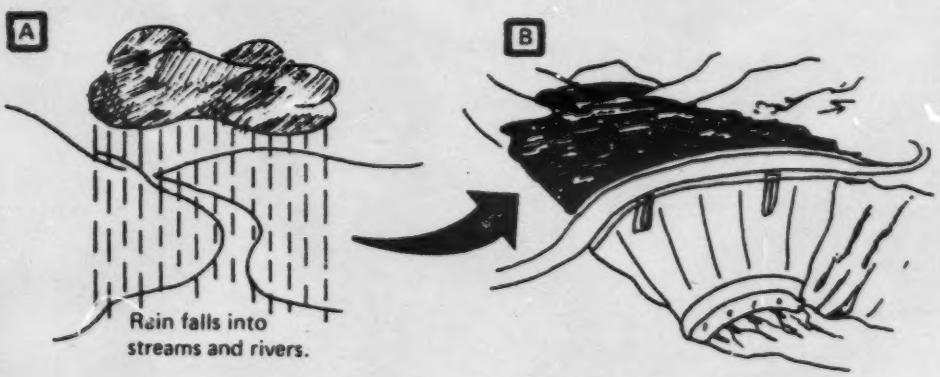


Fig. 13

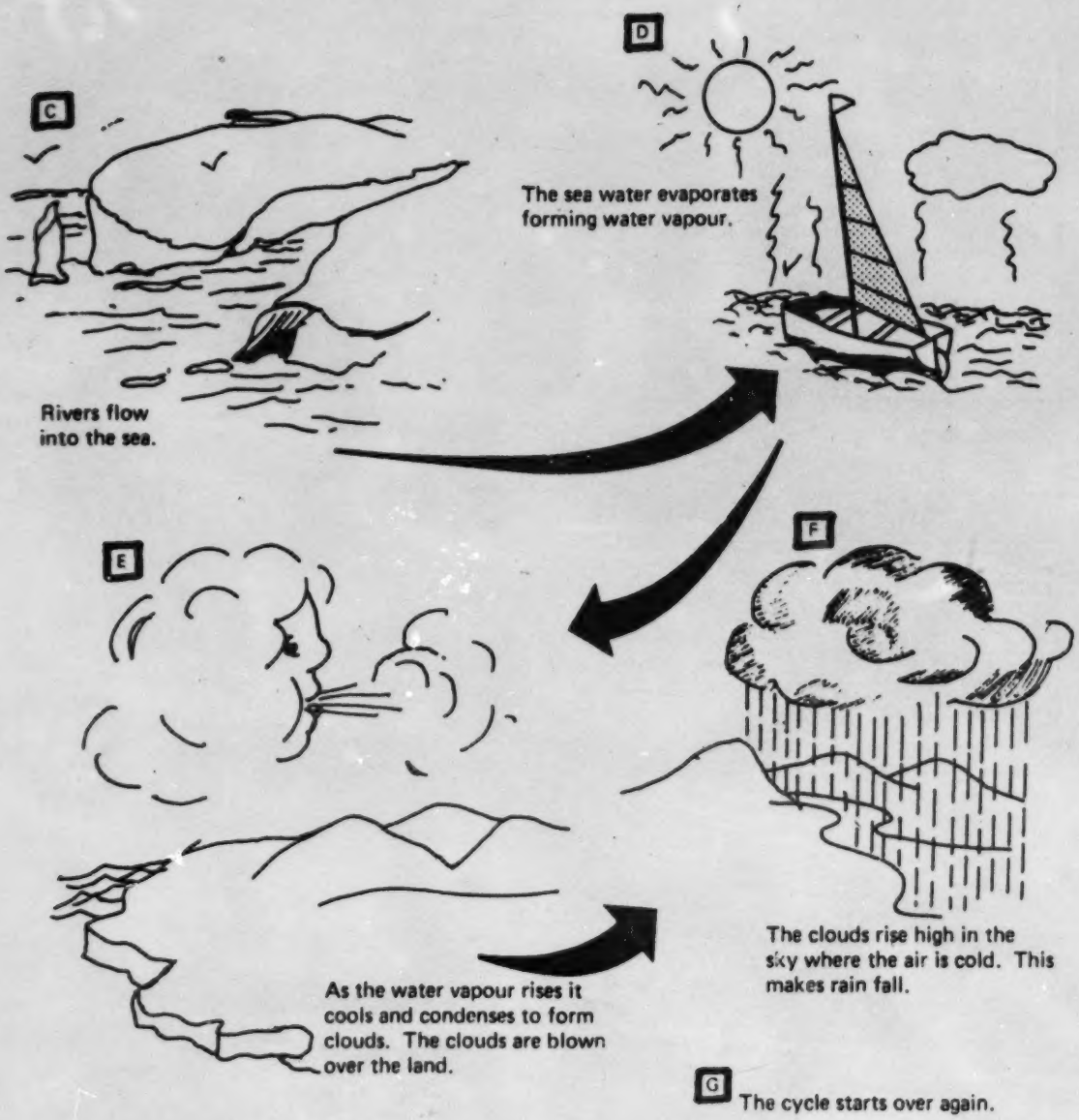

C
Rivers flow into the sea.
D
The sea water evaporates forming water vapour.
E
As the water vapour rises it cools and condenses to form clouds. The clouds are blown over the land.
F
The clouds rise high in the sky where the air is cold. This makes rain fall.
G
The cycle starts over again.

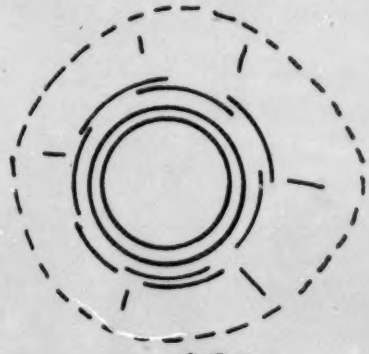
Fig. 14

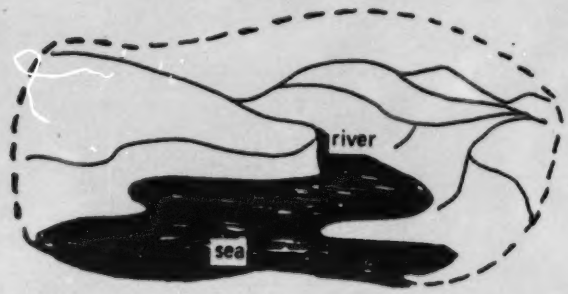
5.2 (2)

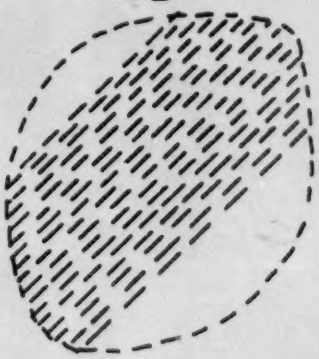
A Water Cycle Cut-out

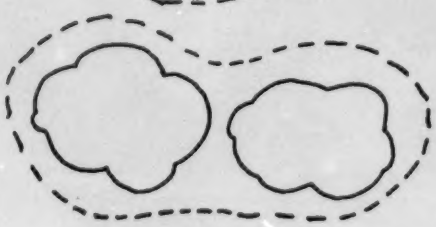
The small pictures are all part of the water cycle.

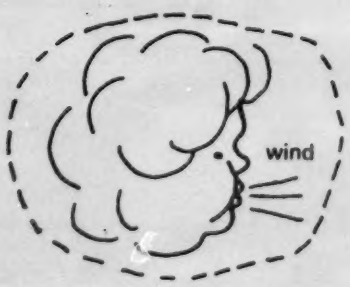
1. Carefully cut out each picture.
2. Without looking at the picture of the complete cycle, decide on the correct order of these small pictures.
3. Stick each picture on your sheet in the correct order to make the water cycle.











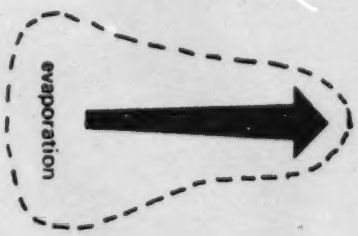


Fig. 15

Name: Class:

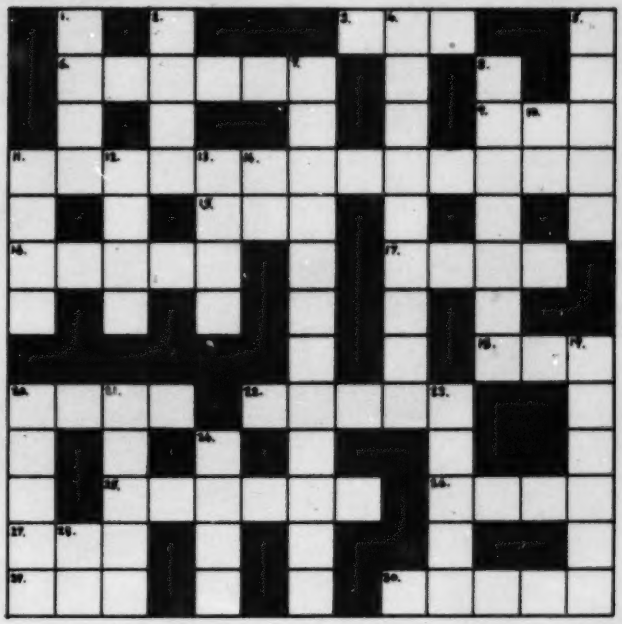
Made of Water in Nature 5.2 g

Many things in nature are made of water, like rivers and fog. How many can you think of in nature? If you get over 25 you are doing very well.

1. river	26.
2. Fog	27.
3.	28.
4.	29.
5.	30.
6.	31.
7.	32.
8.	33.
9.	34.
10.	35.
11.	36.
12.	37.
13.	38.
14.	39.
15.	40.
16.	41.
17.	42.
18.	43.
19.	44.
20.	45.
21.	46.
22.	47.
23.	48.
24.	49.
25.	50.

Name: Class:

5.3 The Water Crossword



Clues Across

3. A large amount of water (3).
6. A place with a lot of frozen water (6).
9. A spillage that floats on water (3).
11. For water it is 0°C (8,5).
15. A river's mouth is at its _ _ _ (3).
16. Flowing water (5).
17. Falling water (4).
18. The state of steam (3).
20. They live in water (4).
22. Water going up and down (5).
25. What ice turns to when it melts (6)
26. The shore is at the loch's _ _ _ _ (4).
27. Wet wood does this (3).
29. Not wet (3).
30. Water turned to gas (5).

Clues Down

1. Not raining (4).
2. A large area, but not of water (4).
4. Water in a puddle will do this when it is sunny (9).
5. What ice does at 10 °C (5).
7. The change gas to liquid (12).
8. What water is doing as it turns to steam (7).
10. Not out of water, _ _ it (2).
11. It is put out by water (4).
12. Jealousy of our swimming pool makes some people turn green with _ _ _ _ (4).
13. The Celsius temperature at which pure water turns solid (4).
14. When you are snowed up you are snowed _ _ (2).
19. Water on the move (6).
20. Sea water inlet in Norway (5).
21. The sea is this, especially the Dead Sea (5).
23. Watery snowfall (5).
24. Part of aquarium which is Latin for water (4).
28. Alternative (2).

NAME: CLASS:

WORD SEARCH 5.4.f

D	T	E	W	D	S	E	T	A	R	O	P	A	V	E
I	S	O	L	I	D	S	L	A	T	S	Y	R	C	L
S	N	U	H	U	N	E	N	A	E	C	O	M	O	C
S	S	S	N	Q	O	D	T	S	S	E	A	R	N	Y
O	D	H	O	I	I	R	G	A	S	E	E	E	D	C
L	U	D	A	L	T	I	O	L	R	K	T	V	E	R
V	O	L	E	I	U	P	F	T	A	U	A	I	N	E
E	L	O	C	H	L	B	S	L	E	E	T	R	S	T
S	C	C	I	B	O	I	L	I	N	G	S	A	E	A
R	I	O	V	E	S	E	R	E	R	A	I	N	S	W

The words may be backwards, forwards, up, down, or diagonal, but always straight.
As you find each work draw a straight line through it in the diagram.
Letters can be used in more than one word.

The words to search for are:

1. boiling
2. clouds
3. cold
4. condenses
5. crystals
6. dissolves
7. drip
8. evaporates
9. fog
10. gas
11. hail
12. hot
13. ice
14. insoluble
15. lake
16. liquid
17. loch
18. ocean
19. rain
20. reservoir
21. river
22. salt
23. saturated
24. sea
25. sleet
26. snow
27. solid
28. solution
29. state
30. stress
31. sun
32. water cycle
33. wet

Scoring - One point for each work found
- Two points each for giving the meaning of words containing a black square. (Answer spaces below).
- One bonus point for finding all 33 words.

You are shooting for a maximum score of 40. Good luck!

1. _____

2. _____

3. _____

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Appendix B

Nan Calder, Westwood Secondary School, Glasgow

WORKSHEETS

While sharing most, though not all, of the views on learning strategies expressed in this article, I would dispute the central role of the worksheet. The miscasting is exemplified by the use of a phrase like "Worksheet Systems", apparently almost a syromym for individualised learning systems. The objectives of such learning systems are achieved through many media: booklets, tapes, slides, concrete apparatus, etc. and, conversely, good worksheets have been used successfully in more traditional teaching. I should like, therefore, to present a narrower, functionally defined, view of what a worksheet is and for what purposes it can profitably be used.

The work card referred to in this article is, I believe, merely one administrative tool, the most convenient in some settings, better replaced by books, tapes or oral instructions in others, but not by reason of its form germane to the learning process. I would include in my definition of a worksheet, therefore, only the consumable variety. There are, however, several ways of "consuming" a worksheet other than by writing on it. A worksheet may be written on, drawn on, folded, cut up, pasted. It is a simple piece of apparatus to be used actively during the learning process.

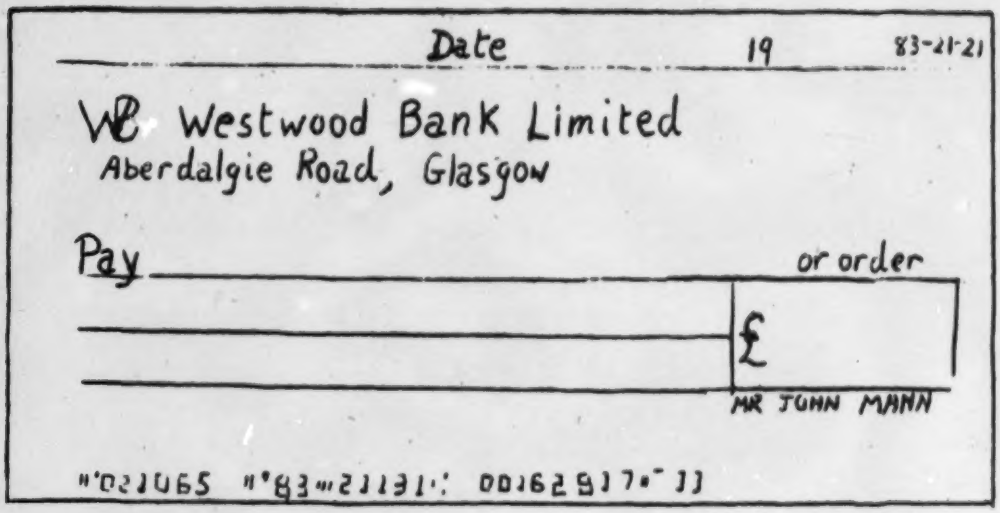
Worksheets, I would suggest, should be preferred to other media in the following situations:

1. To simulate form filling. If the actual forms can be acquired these make the best worksheets of all. If this is not possible, the forms should be copied as closely as the law and available reprographic facilities allow. Examples 1 and 2.
2. To provide a format for recording or tabulating results. Without this the pupil would at best be involved in fruitless copying exercises and at worst have his attention distracted from the real learning task to the peripheral one. Examples 3 and 4.
3. To provide a backcloth which the pupil could not be expected to produce for himself with sufficient competence to make the ensuing task meaningful. Examples 4, 5 and 6.
4. To make an experiment. Examples 7 and 8.

The worksheet on the Theorem of Pythagoras is included here to illustrate a point made earlier regarding the dangers of equating the use of worksheets with particular methodologies. This worksheet was used in a class teaching situation, but in an individualised system has been superseded by apparatus sturdier in construction and more flexible in use, particularly in allowing extended activities for children whose spatial perception remains largely haptical.

Examples 2 and 3 are M.G.E. worksheets.
Examples 4, 5 and 7 are I.M.U. worksheets.
Example 6 is a DIME worksheet.
Examples 1 and 8 are home-made.

EXAMPLE 1



EXAMPLE 2

	Hours		
D. Steele	a.m.	p.m.	Total
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			
TOTAL			
Less $\times \frac{1}{4}$ hour =			
Hours to be paid =			

EXAMPLE 3

Sentence length

Worksheet 1

Name _____

Title of book _____

No. of words	Tally	No. of sentences	Total no. of words	No. of words	Tally	No. of sentences	Total no. of words
1				27			
2				28			
3				29			
4				30			
5				31			
6				32			
7				33			
8				34			
9				35			
10				36			
11				37			
12				38			
13				39			
14				40			
15				41			
16				42			
17				43			
18				44			
19				45			
20				46			
21				47			
22				48			
23				49			
24				50			
25				51			
26					Total	20	

Average length of sentence = $\frac{\text{Total number of words}}{20}$ = _____

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EXAMPLE 4 (copy from a school-made ink stencil)

4 C 2 WORKSHEET 2.

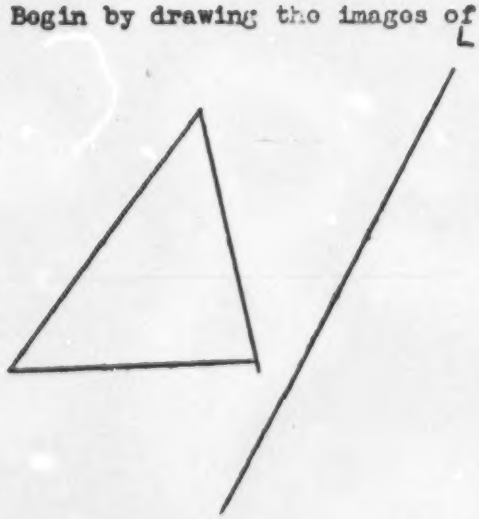
Draw the image of each set of points in L. Use a ruler and set-square.

a)

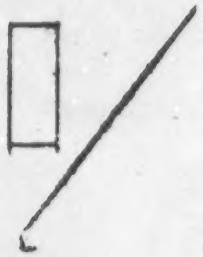
b)

c)

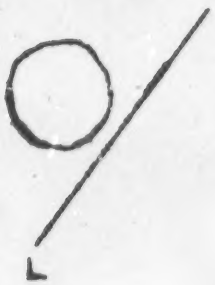
d) Begin by drawing the images of the corners of the triangle.



e)



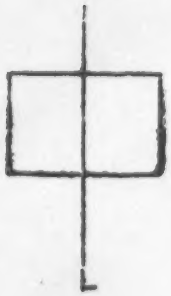
f)



g)

h)

i)



EXAMPLE 5 (copy from a school-made ink stencil)

4 C 2 WORKSHEET 3

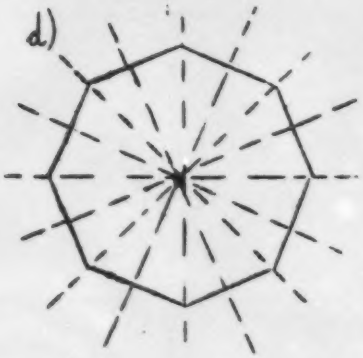
Draw all the axes of symmetry. We have done a) and d) for you.

a)

b)

c)

d)

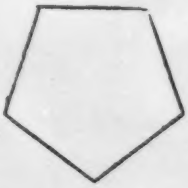


e)

f)

g)

h)



i)

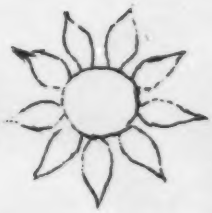
j)

k)

l)

m)

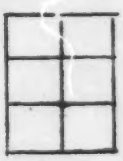
n)



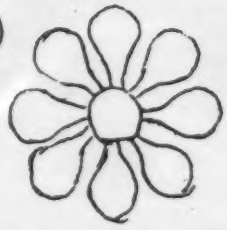
o)

p)

q)

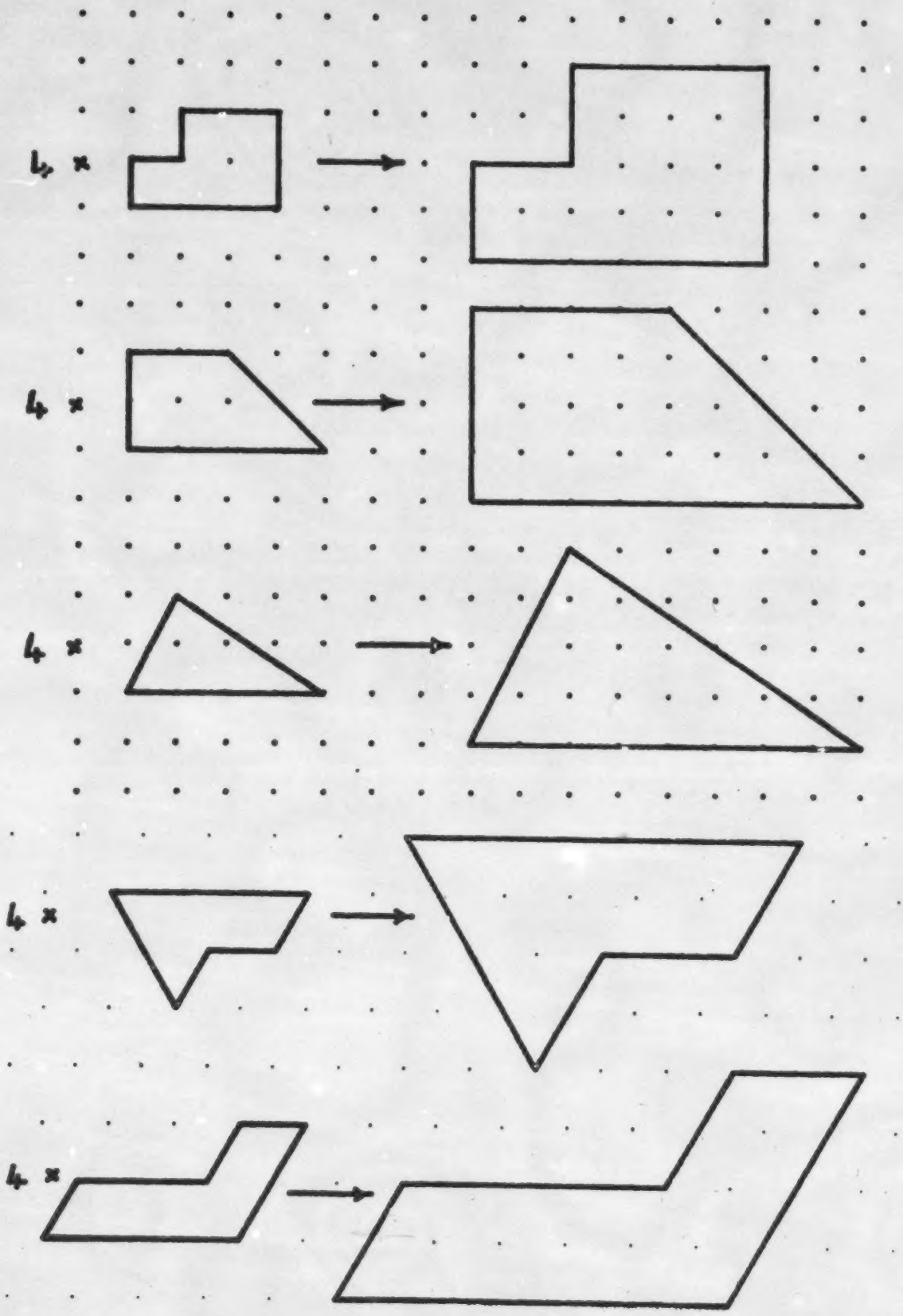


r)



EXAMPLE 6

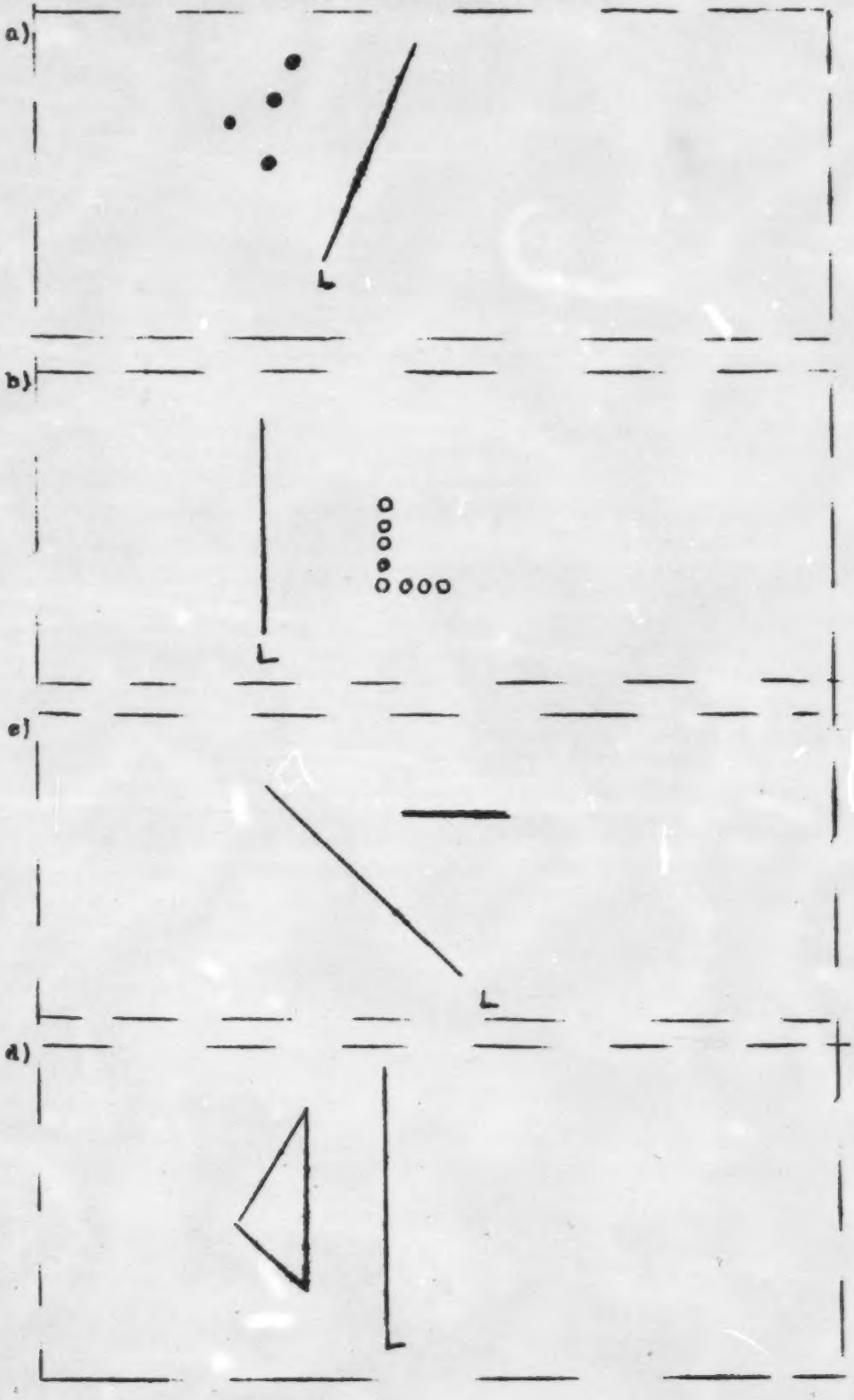
Sheet 33.6



EXAMPLE 7 (copy from an ink stencil)

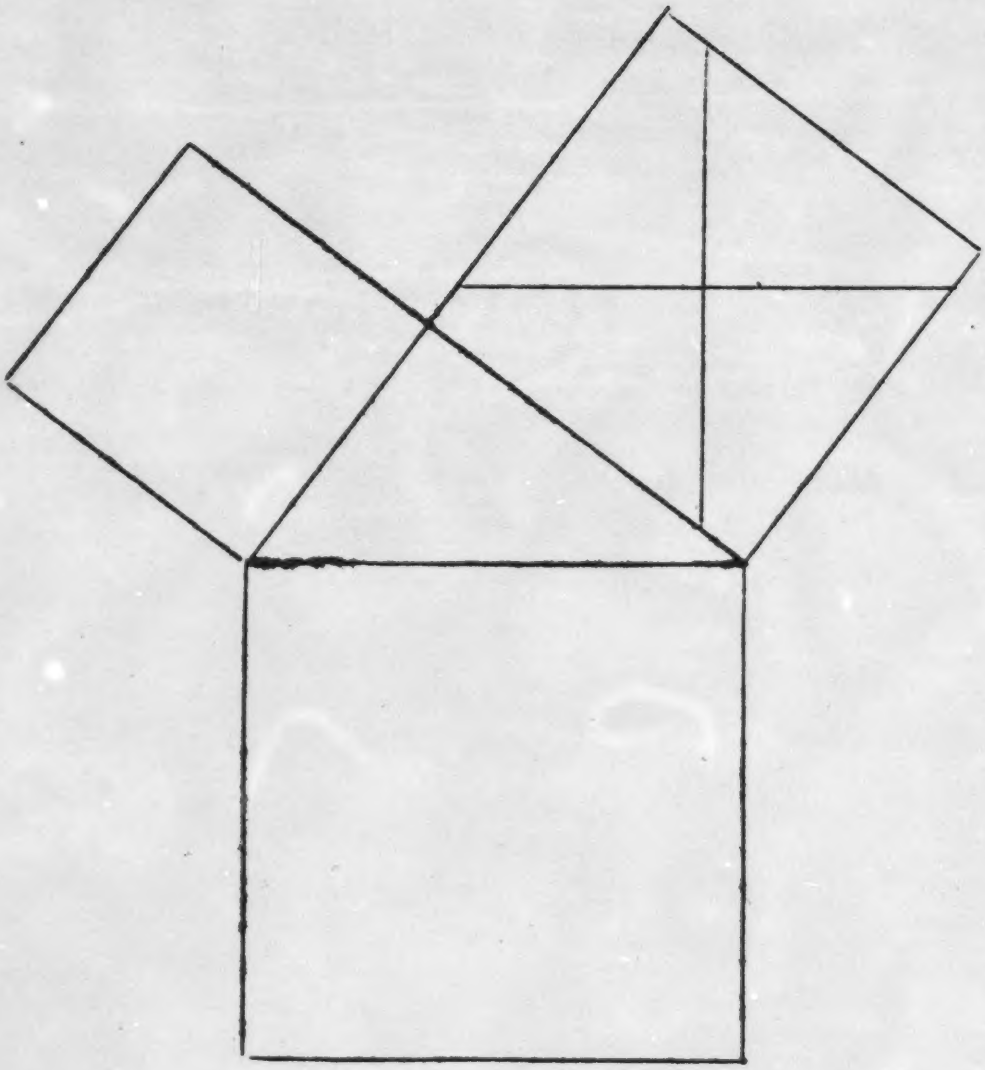
4C WORKSHEET 1

Now YOU are going to draw some images. Cut out each diagram and reflect the set of points in the line.



EXAMPLE 8

Theorem of Pythagoras



Appendix C

COMMENT ON "WORKSHEETS AND SCHOOL LEARNING"

S. H. Kellington,
Glasgow College of Technology

The authors in their title and introductory sections emphasise that their main concern is with the promotion of strategies which encourage ALL pupils to learn. Worksheets and other resource materials are seen assisting the learning process but the key features of their strategies are the teacher/pupils and pupil/pupils interactions. They are to be complimented on their approach to the extremely difficult task of motivating pupils and facilitating learning in the classroom and on their view of the role of worksheets. It can so easily happen in the use of worksheets, as the authors remind us, that worksheets become the dominant feature in classrooms with the teacher acting as a supervisor in the almost clerical task of completing sentences and filling gaps. The creation of an "impoverished learning environment by submitting pupils to the inappropriate use of worksheets" is a danger worthy of the emphasis given.

In view of the authors' main concern with learning /teaching strategies, it is appropriate to consider some of the features of their strategies before examining some of their recommendations on worksheet design and their relevance to other schools.

It is clear that the authors value highly the relationship between the teacher and pupil both in the development of attitudes and the promotion of learning. A particularly demanding aspect of their strategy which relies heavily on this relationship is the need for the teacher to assess whether individual pupils have mastered the necessary pre-requisite knowledge and skills BEFORE learning tasks are allocated. Although an example is quoted of a "Readiness Test" from the ASEP scheme, it appears that the authors rely on discussions between the teacher and individual pupils or groups of pupils for such assessment and any remedial help required. In any case, it would be a daunting task to provide worksheets which would cover all possible deficiencies in pupils' understanding! The authors recommend, however, the work of Piaget when selecting activities for worksheets although it should be remembered that the level of development of individual pupils may well vary for different topics.

After this initial assessment of pupils' knowledge, the authors attempt to match learning activities to individual pupils. In common with the new Scottish Integrated Science scheme, they provide a fairly limited selection of alternative activities and rely on the teacher to direct pupils on appropriate routes through workcards and worksheets. Since the authors value discussions in groups, they have preferred to devise a scheme with a limited selection of activities and routing directed by teachers rather an individualised learning scheme. Their scheme reduces the organisational and apparatus problems associated with individualised learning schemes but requires a compromise in terms of pupils' learning activities. This arises due to the necessity according to Bloom's model, for pupils to be given sufficient time for the mastery of tasks and for allowing substantially different times for different pupils. The restriction of time on a topic for a WHOLE CLASS, therefore, implies that there will be substantial differences in the number of activities attempted by different pupils if each activity attempted is to be mastered. This conflicts with the "public" recording of completed activities which is advocated since recording of this kind will probably encourage pupils to attempt as many activities as possible. The authors recognise this particular problem to some extent, however, and make an allowance for such competition in their recording of credits on a non-linear 'thermometer" scale.

In their recommendations for the design of worksheets per se, the authors include much valuable advice. In view of their promotion of "personalised learning" through pupil/pupil and pupil/teacher interaction, however, it is a pity that they do not explain or give examples of how this can be encouraged through the content of actual worksheets except for the use of checkpoints or tickets. Perhaps instructions for group discussion on resource materials or outlines for group projects could be valuable for encouraging such interactions. The recommendation for giving pupils a measure of control over their learning by allowing some freedom of choice in learning activities is clearly desirable for encouraging motivation in many pupils. Allowing for such choice, however, is likely to lead to considerable proliferation of

materials since the recommendations on language and content levels also require alternative materials. The recommendations on language for worksheets are very sensible when worksheets are to be used for conveying instructions to pupils. Very wisely, moreover, the authors recommend the encouragement of pupil writing and discussion as a means of encouraging language development. Such activities are also likely to lead to a deeper understanding by pupils of the topics being studied.

The authors are clearly enthusiastic for the use of worksheets as one element of resource based learning and for interaction between teachers and pupils. It would be easy to conclude that less enthusiastic teachers in less favourable circumstances would be unable to operate their scheme and to follow all their recommendations. It is more profitable to conclude that there is much value in being "aware of the possibilities and limitations of worksheets" and in being prepared to design or modify the presentation of a course in the light of others' experiences in order to facilitate pupils' learning.

Appendix D

USING WORKSHEETS: PROBLEMS AND POSSIBILITIES

Dr S. J. Ball, Lecturer in Education, Education Area, University of Sussex

The use of worksheets has undoubtedly increased enormously in primary and secondary classrooms in the past ten years, and this increased use has gone almost totally unnoticed by educational researchers. Yet, the introduction of worksheets involves a number of issues of vital concern to those interested in understanding teachers' practices in the classroom.

The use of worksheets obviously has a number of attractions for teachers, especially those confronted with teaching mixed-ability classes. I have argued elsewhere (Ball, 1980a) that the introduction of worksheets may provide a strategy for coping with *situational* pressures in the mixed-ability classroom, especially the problems presented by variations in pupils' speed of working, *and* may also serve to *symbolize* to colleagues an appropriate pedagogic response to the teaching of mixed-ability groups. In other words, the use of worksheets by a teacher does not necessarily indicate a "commitment to certain education concepts", such as those articulated by the writers of the monograph. Several recent reports and studies (Ball, 1980b, D.E.S., 1979, A.M.A., 1972, I.L.E.A., 1976) who have suggested that the majority of teachers give their support to and involve themselves in mixed-ability innovations do so, not because of any firmly held commitment to educational change in itself, but because they expect mixed-ability grouping to put a stop to the alienation of low ability pupils, and the resulting disruption and misbehaviour, that is generated by streaming. For many such teachers the introduction of worksheets into their classroom is a solution to *their* teaching problems and is not a response to the learning problems of their pupils. Often the worksheets produced in these circumstances do little either to individualize learning—diagnose and cater for the unique abilities, needs, interests etc. of pupils—or to increase the pupils' autonomy by "making the work his own" (Goodson, 1975). Rather, many worksheets replicate the transmission mode (Barnes, 1976) of class teaching methods recasting the pupils in the role of passive recipients of knowledge. Indeed, in certain respects the worksheet tends to constrain the pupils' freedom of choice even more than other teaching methods. This is particularly the case in regard to the sorts of writing that is demanded of pupils and the purposes of that writing. The writing required of pupils is predominantly at an analogic level of the informative. This was evident from the Schools Council study "The Development of Writing Abilities (11–18)".

> Our impression is that there is still a great deal of writing done in school, and much of it is now done on worksheets. Though as yet there has been no serious study of written answers on worksheets, our experience would indicate that, with the pressure of external examinations still maintained, an even greater reduction of choices may have taken place.
>
> (Britton *et al.*, 1975: 198)

Britton and his colleagues found little speculative or expressive writing in the samples of pupil's work that they collected, instead teachers gave emphasis to classificatory writing "which reflects information in the form in which both teacher and textbook traditionally present it" (p. 197).

In the main, the purpose of pupils writing on worksheets, including those presented in the monograph, is that of testing the pupils' ability to "rehearse" knowledge. The audience is the teacher as examiner, and the pupils' learning is essentially answer-centred. With the problem of variations in pupils' speed of working to the forefront of the teacher's mind the emphasis is almost exclusively upon pupils' "progress", as this is measured in terms of "coverage" of worksheets. One indication of this is that the normal labelling of pupils by teachers as bright, average, dull etc. is translated into expressions related to speeds of working; quick, slow etc.

The problems of managing learning in the worksheet classroom are exacerbated, as the monograph writers point out, when teaching time is divided into short single or double teaching periods. But the realities of timetabling, especially in a large comprehensive, mean that there are usually limited possibilities for the blocking of subjects, and certainly a strict limit to the number of subjects that can be blocked. Some subjects will inevitably be restricted to teaching in single periods, others, like Modern Languages, are often timetabled in this fashion deliberately. The realities of contemporary schooling need to be recognized when examining the use of worksheets; realities like limited timetable flexibility; poor reprographic facilities in many schools; and limited access to audio or visual aids. Perhaps one should add to this the diverse demands upon teachers' time and energy and the possibility that significant numbers of teachers will be introduced to the use of worksheets against their wishes. In these conditions there is inevitably considerable diversity in the ways in which teachers' incorporate worksheets into their classroom practices. Even within a single department I have observed totally different forms of class room organization which we referred to and discussed together as "using worksheets". For example: (1) pupils may be allowed and encouraged to work collaboratively or they may be isolated from one another to work individually, in competition; (2) pupils may be given considerable freedom to talk and move about the classroom or may be restricted to their desk to work in silence; (3) pupils may be allowed to work at their own pace with little interference by the teacher or the pacing of coverage of worksheets may be strictly determined by the teacher; (4) pupils may be allowed to move at will from one task to another and one worksheet to another or this may be strictly monitored by the teacher; (5) worksheets may be used as an exclusive method or integrated and interspersed with class teaching, group discussions, simulations and games, visits etc. All of these variations have implications for the pupils' experience of learning and may give rise to very different strategies of adaptation of the pupils' part. Where the time-space matrix in the classroom is opened up by the introduction of worksheets so too is the range of strategic possibilities available to the pupil. As the teacher is moving around the classroom dealing with individual queries and difficulties the possibilities for "frittering" by pupils is considerably increased, there may be many more apparently legitimate reasons for not to be working in this situation than is the case in class-taught lessons. As the problems of classroom management increase then the potential for discipline problems can also increase. A complex worksheet system to be operated in a mixed-ability classroom is a daunting prospect for the inexperienced teacher.

Where the teacher is a "scarce resource" in the classroom, subject to the competing demands of pupils, often with very different kinds of need, then we have once again the possibility for some pupils to exploit the situation. Clearly, some pupils have greater skill and willingness to attract their teachers' attention, explain their problems and exploit the teachers' help. In other words, to make a "success" of the worksheet classroom the teacher must come to grips with the differences not only in abilities among pupils but also differences in personality, motivation, social skills and cognitive style. And, it is important to recognize that in any group of over thirty pupils that it is unlikely, indeed probably inconceivable, that they will all be equally comfortable with any one kind of teaching method. Whether it be class teaching or some form of individualized learning, some pupils will find the situation unconducive. And that does not provide an argument for variety, for inevitably some pupils will prefer the security and predictability of a single teaching method, whatever it is. All this, together with the management and control problems embedded in the use of worksheets, greatly increases the skills and energies required of the classroom teacher, and must *inevitably* produce a wide variety in ways that teachers select to work.

The use of worksheets, as noted previously, has increased enormously in our schools in the past ten years and such a widespread "grass roots" educational innovation deserves, indeed requires, systematic examination and analysis. Accounts of good practice, as presented in the monograph here, are important, but there is a clear need for a thorough survey of the employment of worksheets in schools and a study of their uses.

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Appendix E Authors' Responses

EDITORS NOTE: When the comments from the three contributors, Nan Calder and Drs Kellington and Ball had been received the authors were given the opportunity to write brief replies. These are presented, not as rebuttals but as extensions of the debate.

Reply to Comments by Nan Calder

We have tried to emphasise that worksheets should not be the only, or even in many cases the main, way of promoting learning. Indeed, we have pointed out strongly that, used unthinkingly and excessively, they can lead to an "impoverished learning environment". Clearly in some subjects—or even with different teachers in the same subject—the worksheet will play a narrower, though no less important role than we have described. We welcome the samples shown, as examples of "good practice" in another subject area. However, we would emphasise that there are many ways of viewing, and thus defining, worksheets. Different types can all play a valuable part, provided that we are clear on our overall strategy and on how each type is to be used to help achieve this.

Perhaps the term "Worksheet Systems" would have been better re-phrased as "Learning systems which include worksheets"; we used the former because of its brevity and apologise if it has caused unnecessary misunderstanding. However, we definitely do *not* advocate exclusive use of individualised learning systems. Again, these can play a valuable part but we are most concerned that they can so easily inhibit the kinds of co-operative learning and social activities that we strongly advocate.

Reply to comments by Dr Kellington

The authors did not devise the Wester Hailes Science Scheme but use it as an example which illustrates many of the features of worksheet based courses which they value.

At Wester Hailes, contrary to Dr Kellington's remarks, the Science staff are very much aware that the Scottish Integrated Science provides a limited selection of alternative extension activities and are trying to add to these as each unit is reviewed and revised. The staff have preferred to develop a scheme which offers a wide range of alternative learning activities so that all pupils can learn at the appropriate level in a variety of controlled social situations. Their aim is to personalise learning and not produce as Dr Kellington rightly points out an individualised learning scheme.

The Wester Hailes Scheme does include numerous examples where the content of the worksheets encourage interactions. Group games, which are becoming a feature of some units, also the simple but effective "What you have learned" written conclusion to topics which demand pupil/teacher discussion, are examples of interactive activities.

Reply to Comments by Dr Ball

We agree that worksheets are too often used almost exclusively to cope with "situational pressures" rather than as a means to help implement educational concepts. Bloom (op. cit.) lays great stress on the importance of concentrating first of all on "managing the learning" rather than "managing the learners"; this is why we in turn have stressed the educational background to worksheet use. Otherwise, worksheets become a superficial palliative to class management rather than an aid to improved learning.

We have also laid great stress on the importance of speculative and expressive language work (not simply writing). The examples of sheets requiring pupils to rehearse knowledge were mainly used as illustrations of what to *avoid*. On the other hand, Fig. 2 shows examples of kinds of writing that we wish to encourage. The role of the "teacher as examiner" is one that we also strongly deprecate (see para 7, p. 1).

We also agree that pupil progress should not simply be measured by coverage of worksheets—or any other material. Indeed, in our experience it is a fallacy to assume that the "brightest" pupils are always the quickest. We believe that pupils should be given opportunities to study some topics in depth, with the aim of "reporting back" verbally, in writing, or perhaps by a visual presentation of what they have found out. Unfortunately, as Dr Ball has also pointed out elsewhere (Ball, 1980a), the demands of external examinations often cause teachers to go for maximum coverage of content at the expense of real involvement and understanding. We do not accept, however, that this is a valid reason for such an approach.

We do not agree that timetable inflexibility need be a major constraint on longer teaching periods. Many schools are now adopting longer periods. At Wester Hailes Education Centre the standard period is now 75 minutes and many subjects have opted for $2\frac{1}{2}$ hour blocks of time. The "strict limit to the number of subjects that can be blocked" may be overcome by rotating modules of, say, 10-week duration—e.g. 10 weeks of Technical followed by 10 weeks of Home Economics.

Finally, we have attempted to answer the problem of the teacher as a "scarce resource" by the strategies outlined in the section "Managing the Learning". These are descriptions of techniques actually in use with, we believe, a fair measure of success.

The Debate Continues

If you have comments on the topic of worksheets and school learning then these would be welcomed. Letters directed specifically to the authors will be forwarded but SCET would hope that your comments would guide us to possible future work in this field or further publication.

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